# ZLAC8030L SERVO DRIVER (SPECIAL FOR HUB SERVO MOTOR)

# CANopen COMMUNICATION INSTRUCTION

| Version | Description | Date |
|---------|-------------|------|
| V1.00 | - | 2021-01-14 |
| V1.02 | 1. Current unit 0.1A;<br>2. Add the power cable short circuit function after the alarm (202F PWM processing method) | 2022-7-15 |

# CATALOG

# 1.OUTLINE

This manual only gives a brief introduction to the most commonly used related concepts and precautions in the use of ZLAC8030L, so that users can understand the normal use of ZLAC8030L series products in the shortest time.

**Communication Standard followed by ZLAC8030L**
- CAN 2.0A Standard
- CANopen Standard protocol DS 301 V4.02
- CANopen Standard protocol DS 402 V2.01

**The following description takes the driver address as 1, the baud rate as 500K.**

The driver address can be set to 0-127. The address 1-3 could be set by DIP switch. When the DIP switch is set to 0, the address could be set through software, its range is 4-127, the default address is 4.
For CANopen communication, ZLAC8030L has 7 optional baud rates: 25kHz, 50kHz, 100kHz, 125kHz, 250kHz, 500kHz, 1MHz. Baud rate could be set through software, its default value is 500kHz.

# 2. CIA301 DESCRIPTION

## 2.1 CANOPEN FUNCTION DESCRIPTION

### 2.1.1 Message Classification

| Object | Standard | Function Code |
|---|---|---|
| NMT(Network Management) | CiA301 | 0000 |
| Sync Message | CiA301 | 0001 |
| TPDO1 send process data object 1 | CiA301 | 0011 |
| RPDO1 receive process data object 1 | CiA301 | 0100 |
| TPDO2 send process data object 2 | CiA301 | 0101 |
| RPDO2 receive process data object 2 | CiA301 | 0110 |
| TPDO3 send process data object 3 | CiA301 | 0111 |
| RPDO3 receive process data object 3 | CiA301 | 1000 |
| TPDO4 send process data object 4 | CiA301 | 1001 |
| RPDO4 receive process data object 4 | CiA301 | 1010 |
| SDO service data object (Service data object response) | CiA301 | 1100 |
| SDO service data object (service data object inquiry) | CiA301 | 1011 |

### 2.1.2 Object Dictionary

Object Dictionary is the core concept of CANopen. Every CANopen device in the network has an object dictionary. Object Dictionary is an ordered collection of data objects. These objects describe all the communication and device parameters of the device, and their positions are determined in Object Dictionary by a 16-bit index and an 8-bit subindex.

**Object Dictionary supported by ZLAC8030L**

| Index Range | Description |
|---|---|
| 0x1000-0x1A03 | CiA301 Communication Object Sub-Protocol Area |
| 0x2003-0x2030 | Factory Custom Area |
| 0x603F-0x60FF | CiA402 Motion Control Sub-Protocol Area |

## 2.2 SDO MESSAGE DESCRIPTION

SDO is mainly used by CANopen master to configure the parameters of slave nodes. Service confirmation is the   biggest feature of SDO. It generates a response for each message to ensure the accuracy of data transmission. Usually CANopen takes slave node as SDO server, master node as the client (called CS communication). The SDO client could access Object Dictionary on the SDO server through index and sub-index.

### 2.2.1 SDO Message Format

| COB-ID | Data | Description |
|---|---|---|
| 0x600 + Node Address | Command   Word   +   Index   + Sub-Index + Data | Master station send |
| 0x580 + Node Address | | Slave station reply |

### 2.2.2 COB-ID Description

In CANopen protocol, it is stipulated that 11 arbitration bits are divided into the high 4 bits of the Function Code and the low 7 bits of the node address (Node-ID), which is called COB-ID (Communication Object Identifier).

| | CANopen predefined master / slave connection set | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| Function Code | | | | Node-ID | | | | | | |

### 2.2.3 Command Word Description

| Command | Function | Type | Data Length |
|---|---|---|---|
| 2F | Setting | M->S Request | 1 byte |
| 2B | Setting | M->S Request | 2 byte |
| 27 | Setting | M->S Request | 3 byte |
| 23 | Setting | M->S Request | 4 byte |
| 60 | Setting feedback | S->M Confirm | |
| 40 | Read | M->S Request | 0 byte |
| 4F | Read feedback | S->M Answer | 1 byte |
| 4B | Read feedback | S->M Answer | 2 byte |

| 47 | Read feedback | S->M Answer | 3 byte |
|----|---------------|-------------|--------|
| 43 | Read feedback | S->M Answer | 4 byte |
| 80 | Error | S->M Answer | 4 byte |

### 2.2.4 SDO Message Routine

| Master Station | Slave Station | Function Description |
|----------------|---------------|----------------------|
| 601:<br><br>23 7A 60 00 00 10 00 00 | 581:<br><br>60 7A 60 00 00 00 00 00 | Write target position 4096 |

## 2.3.NMT MESSAGE DESCRIPTION

### 2.3.1 NMT Node Status

| Status | Description |
|--------|-------------|
| Initialization | Initialize CAN controller after the node is powered on. |
| Application layer reset | Node application reset |
| Communication reset | Node CANopen communication reset |
| Pre-operational state | Node CANopen communication is in operation;<br>Could communicate with SDO and NMT. |
| Operating state | After the node receives the start command sent by NMT master station, the node's PDO communication is activated. |
| Stop state | After the node receives the stop command from NMT master station, the node's PDO communication is prohibited. |

### 2.3.2 NMT Slave Node Online Message

After any NMT slave node goes online, in order to remind the master station that it has joined the network, this slave station must send the node online message, as shown in the following table:

| COB-ID | Data | Description |
|--------|------|-------------|
| 0x700+ Node Address | 0x00 | Slave node goes online |

### 2.3.3 NMT Slave Node Status and Heartbeat Message

In order to monitor whether the CANopen node is online and the current node status. In CANopen application, it is usually required that the slave stations that are powered on and online send heartbeat messages regularly, so that the master station could confirm whether the slave station is faulty and whether it is off the network.

The heartbeat message format is as follows:

| COB-ID | Data | Description |
|--------|------|-------------|
| 0x700 + Node Address | 0x04 | Stop state |
| 0x700 + Node Address | 0x05 | Operation state |
| 0x700 + Node Address | 0x7F | Pre-operational state |

The CANopen slave station sends the heartbeat message according to the heartbeat production time (ms) filled in 1017h in its object dictionary, and CANopen master station (NMT master station) will check according to the heartbeat consumption time filled in its 1016h. Assuming that more than a few

heartbeat consumption times, CANopen master (NMT master) has not received the heartbeat message from the slave station, it is considered that the slave station is offline or damaged.

### 2.3.4 NMT Node State Switching Command

In NMT network management, the core is NMT node status switching command, which is the "command" message for network management performed by NMT master station. Users must keep these commands in mind.

All COB-ID is 0x000, with the highest CAN priority, and the data is 2 bytes:

| COB-ID | Data 1 | Data 2 | Description |
|---|---|---|---|
| 0x000 | 0x01 | 0xNode address | Start command (let the node enter Operating state) |
| 0x000 | 0x02 | 0xNode address | Stop command (let the node enter the stop state) |
| 0x000 | 0x80 | 0xNode address | Pre-operation command (let the node enter the pre-operation state) |
| 0x000 | 0x81 | 0xNode address | Reset the node application layer (let the node enter the application layer reset state) |
| 0x000 | 0x82 | 0xNode address | Reset node communication (let the node enter the communication reset state) |

If user wants to control all the nodes of the entire network, the node address of data 2 could be 0x00.

### 2.3.5 NMT Heartbeat Message Configuration Routine

| Master Station | Slave Station | Function Description |
|---|---|---|
| 601:<br>2B 17 10 00 00 00 E8 03 | 581:<br>60 17 10 00 00 00 00 00 | Set heartbeat production time 1000. |

## 2.4. PDO MESSAGE DESCRIPTION

PDO belongs to process data, which is used to transmit real-time data, that is, one-way transmission. It does not need to receive CAN message that node responds to confirm. From the perspective of communication terms, it belongs to the "production and consumption" model.

### 2.4.1 PDO COB-ID Definition

| Object | Standard | COB-ID |
|---|---|---|
| TPDO1 send process data object 1 | CiA301 | 0x181-0x1FF (0x180+Node address) |
| RPDO1 receive process data object 1 | CiA301 | 0x201-0x27F (0x200+Node address) |
| TPDO2 send process data object 2 | CiA301 | 0x281-0x2FF (0x280+ Node address) |
| RPDO2 receive process data object 2 | CiA301 | 0x301-0x37F (0x300+ Node address) |
| TPDO3 send process data object 3 | CiA301 | 0x381-0x3FF (0x380+ Node address) |
| RPD3 receive process data object 3 | CiA301 | 0x401-0x47F (0x400+ Node address) |
| TPDO4 send process data object 4 | CiA301 | 0x481-0x4FF (0x480+ Node address) |
| RPDO4 receive process data object 4 | CiA301 | 0x501-0x57F (0x500+ Node address) |

## 2.4.2 PDO Transmission Form

| Type | Description |
|---|---|
| Event trigger | If the content of the object data mapped to PDO changes, the PDO transmission is triggered. |
| Timer trigger | PDO periodically triggers transmission at the time set by timer. |

## 2.4.3 PDO Communication Parameters

PDO communication parameters define COB-ID, transmission type, timing period that the device uses. RPDO communication parameters are located at 0x1400 to 0x15FF in the object dictionary index, TPDO communication parameters are located at 0x1800 to 0x19FF in the object dictionary index. Each index represents a PDO communication parameter set, and the sub-indexs respectively refer to specific various parameters. As shown in the following table:

| Index | Sub-Index | Description | Data type |
|---|---|---|---|
| RPDO:<br>0x1400-0x1403<br><br><br>TPDO:<br>0x1800-1803 | 0x00 | Number of sub-indexes | U8 |
| | 0x01 | COB-ID: COB-ID that sends/receives this PDO | U32 |
| | 0x02 | Transmission form:<br>0xFE: Event trigger<br>0xFF: timer trigger | U8 |
| | 0x03 | Production prohibition time | U16 |
| | 0x04 | Maintain | U8 |
| | 0x05 | Timer trigger time | U16 |

Note:

Number of sub-indexes: the number of sub-indexes under this index.

COB-ID: the corresponding CAN frame ID when this PDO is sent or received.

Transmission type: this product currently supports only 2 PDO trigger methods.

Production prohibition time: restrict the minimum interval of PDO transmission to avoid dramatic increase in bus load.

Timer trigger time: this parameter defines the time of the PDO transmission form's timer trigger method.

## 2.4.4 PDO Mapping Parameters

| Index | Sub-Index | Description | Data Type |
|---|---|---|---|
| RPDO:<br>0x1600-0x1603<br><br><br>TPDO:<br>0x1A00-1A03 | 0x00 | Number of object mappings | U8 |
| | 0x01 | PDO0 | U32 |
| | 0x02 | PDO1 | U32 |
| | 0x03 | PDO2 | U32 |
| | 0x04 | PDO3 | U32 |

Note:

Number of PDO mappings: the number of objects mapped under the current index, it's the sum of the mappings under the sub-index 1/2/3/4.

PDO1/2/3/4: fill in the information of the object dictionary to be mapped, such as index, sub-index, and data type.

## 2.4.5 PDO Configuration Routine

Upload when the configuration bus voltage (0x2048) changes:

| Master station | Slave station | Function Description |
|---|---|---|
| 601:<br>2F 00 1A 00 00 00 00 00 | 581:<br>60 00 1A 00 00 00 00 00 | Clear TPDO0 mapping |
| 601:<br>23 00 1A 01 10 00 48 20 | 581:<br>60 00 1A 01 00 00 00 00 | Mapping 2048 00 to 1A 00 01 |
| 601：<br>23 00 18 01 81 01 00 00 | 581：<br>60 00 18 01 00 00 00 00 | Set the COB-ID of TPDO0 to 181 |
| 601：<br>2F 00 18 02 FE 00 00 00 | 581：<br>60 00 18 02 00 00 00 00 | Set the transmission mode of TPDO0 to event trigger |
| 601：<br>2F 00 1A 00 01 00 00 00 | 581：<br>60 00 1A 00 00 00 00 00 | Start TPDO0 mapping |

## 2.4.6 Save PDO Mapping

| Master station | Slave station | Function Description |
|---|---|---|
| 601:<br>2F 10 20 00 02 00 00 00 | 581:<br>60 10 20 00 00 00 00 00 | Save the configured PDO to EEPROM |

# 3. CIA402 DESCRIPTION

## 3.1. CIA402 STATE MACHINE

CiA402 protocol defines the standard state machine of motion control device, as well as various operating modes and their definitions in object dictionary.

State machine describes the state of the device and the possible control sequences of driver. The status of each step represents a specific internal or external behavior, and the status of the device also determines which commands could be received.
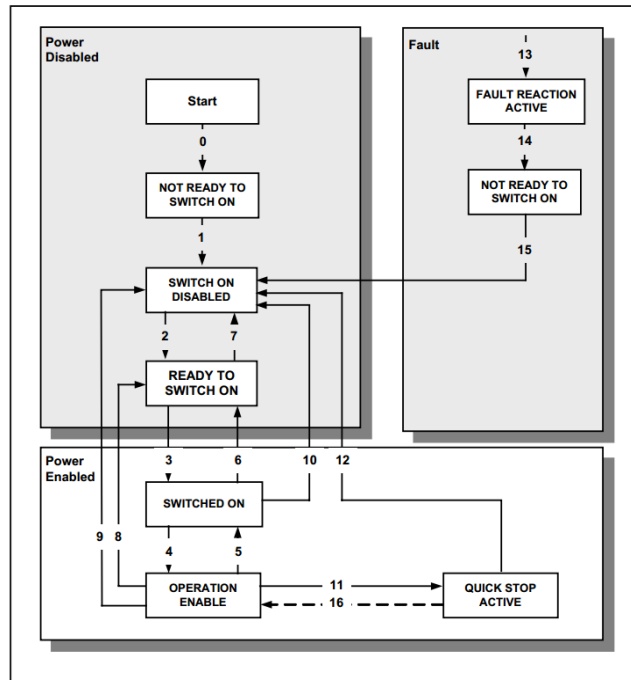
Driver state machine

※ **The corresponding state description of the state machine is as follows:**

| State Name | Description |
|---|---|
| NOT READY TO SWITCH ON | It only supplies power to the driver chip, the driver is initializing and self-checking, the driver function is not enabled, and this state is an internal state. |
| SWITCH ON DISABLED | After the driver is initialized, the driver parameters are established and could be modified. This state does not supply power to the motor. This state is the lowest state that user can operate. This state is also the state that use will contact after the driver is powered on. |
| READY TO SWITCH ON | The driver parameters could be modified, the driver function is not enabled, waiting to enter SWITCH ON state. |
| SWITCH ON | Provide high voltage to the driver, the power amplifier is ready, the driver parameters could be modified, and the driver function is not enabled. |
| OPERATION ENABLE | If no fault is detected, the driver function is enabled, and the motor is powered on. The driver parameters could be modified. According to BP [N] parameter, it is determined whether the brake will be automatically released in this state. |
| QUICK STOP ACTIVE | The driver parameters could be modified, the emergency stop function is enabled, the driver function is enabled, and the motor is powered on. |
| FAULT REACTION ACTIVE | The driver parameters could be modified, the driver has a fault, the fault response function is enabled, and the drive function is disabled. This state cannot be entered manually. The driver will enter this state automatically when a fault occurs. |

Driver state machine is controlled by bit0-bit3, bit7 of the control word (object 6040h). The specific description is as follows:

※ **Control word switching state:**

| Command | Control Word | | | | | State Switch |
|---|---|---|---|---|---|---|
| | Bit7 | Bit3 | Bit2 | Bit1 | Bit0 | |
| Shutdown | 0 | X | 1 | 1 | 0 | 2,6,8 |
| Switchon | 0 | 0 | 1 | 1 | 1 | 3 |
| Switchon +Enable operation | 0 | 1 | 1 | 1 | 1 | 3+4 |
| Disable voltage | 0 | X | X | 0 | X | 7,9,10,12 |
| Quick stop | 0 | X | 0 | 1 | X | 7,10,11 |
| Disable Operation | 0 | 0 | 1 | 1 | 1 | 5 |
| Enable Operation | 0 | 1 | 1 | 1 | 1 | 4,16 |
| Fault reset | ⌐ | X | X | X | X | 15 |
| Bit marked as X is invalid. | | | | | | |

Each state in state machine could be displayed through bit0-bit3, bit5, bit6 of status word (object 6041h), the specific description is as follows:

※ **Status word switching state**

| State | State word | | | | | |
|---|---|---|---|---|---|---|
| | Bit6 | Bit5 | Bit3 | Bit2 | Bit1 | Bit0 |
| Not ready to switch on | 0 | X | 0 | 0 | 0 | 0 |
| Switch on disabled | 1 | X | 0 | 0 | 0 | 0 |
| Ready to switch on | 0 | 1 | 0 | 0 | 0 | 1 |
| Switched on | 0 | 1 | 0 | 0 | 1 | 1 |
| Operation enabled | 0 | 1 | 0 | 1 | 1 | 1 |
| Quick stop active | 0 | 0 | 0 | 1 | 1 | 1 |
| Fault reaction active | 0 | X | 1 | 1 | 1 | 1 |
| Fault | 0 | X | 1 | 0 | 0 | 0 |
| Bit marked as X is invalid. | | | | | | |

## 3.2. CONTROL WORD AND STATUS WORD

The start and stop control commands and state description of the driver are mainly realized through the control word 6040h and the status word 6041h. Therefore, the skilled use of the control word and status word is very necessary. The following table briefly describes the definition of the control word and status word.

| Control Word | Common Command | Function Description |
|---|---|---|
| 6040h | 00 | Initialization step 0: At this time, the low 4-bit status of 6041 is   0000, motor is released; |
| | 06 | Initialization step 1: At this time, the low 4-bit status of 6041 is 0001, motor is released; |
| | 07 | Initialization step 2: At this time, the low 4-bit status of 6041 is 0011, motor is enabled; |
| | 0F | Initialization step 3: At this time, the low 4-bit status of 6041 is 0111, motor is enabled; |
| | 0F | Start command in Profile Velocity Mode (6061 = 3); |
| | 0F->1F | Start command in Profile Torque Mode (6061 = 4); Absolute motion start command in position mode (6061 = 1); |
| | 4F->5F | Relative motion start command in position mode (6061 = 1); |

| Status Word | Bit Definition | Function Description |
|---|---|---|
| 6041h | Bit0~Bit3 | 6040=0： xxxx xxxx xxxx 0000<br>6040=6： xxxx xxxx xxxx 0001<br>6040=7： xxxx xxxx xxxx 0011<br>6040=F： xxxx xxxx xxxx 0111 |
| | Bit7 | 0: driver is normal;<br>1: driver alarms; |
| | Bit8 | 0: torque is not completed;<br>1: torque has been completed; |
| | Bit11 | 0: the status of Bit4 at 6040h is 0;<br>1: the status of Bit4 at 6040h is 1; |
| | Bit13 | 0: motor release;<br>1: motor is enabled; |
| | Bit14 | 0: motor is stopped;<br>1: motor is running; |
| | Bit15 | 0: The motion is not in position in position mode;<br>1: The motion is in position in position mode; |

Eg: Initialize the driver after power-on. After initialization, it enters the normal operation state. This operation is generally performed after power-on.

| Master station | Slave station | Status word of slave station |
|---|---|---|
| 00: 01 00 | NMT initialization | NMT initialization |
| 601:<br>2B 40 60 00 00 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | 6041:<br>xxxx xxxx xxxx 0000 |
| 601:<br>2B 40 60 00 06 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | 6041:<br>xxxx xxxx xxxx 0001 |
| 601:<br>2B 40 60 00 07 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | 6041:<br>xxxx xxxx xxxx 0011 |
| 601:<br>2B 40 60 00 0F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | 6041:<br>xxxx xxxx xxxx 0111 |

CANopen sets the operation mode of the driver through the object 6060h (Mode of Operation) and reflects the current operation mode status of the driver through the object 6061h (Mode of operation display). ZLAC8030L series driver currently supports 3 operation modes: Profile Position Mode, Profile Velocity Mode, and Profile Torque Mode.

※ **Driver Operation Mode:**

| Index | Sub-Index | Name | Type | Attribute | PDO Mapping | Parameter Range | Default |
|---|---|---|---|---|---|---|---|
| 6060h | 00 | Operation Mode | I8 | RW | NO | 0: undefined<br>1: Profile Position Mode<br>3: Profile Velocity Mode<br>4: Profile Torque Mode | 0 |

## 3.3. PROFILE POSITION MODE

### 3.3.1 Profile Position Mode Description

Profile position mode is realized by an S-shaped acceleration and deceleration curve. User could set several parameters such as initial speed (address 200800h), maximum speed (address 608100h), acceleration time (address 608300h), deceleration time (address 608400h) and total pulse number (address 607A00h) through the bus   to achieve precise position control. The S-shaped acceleration / deceleration curve is shown in the figure below.
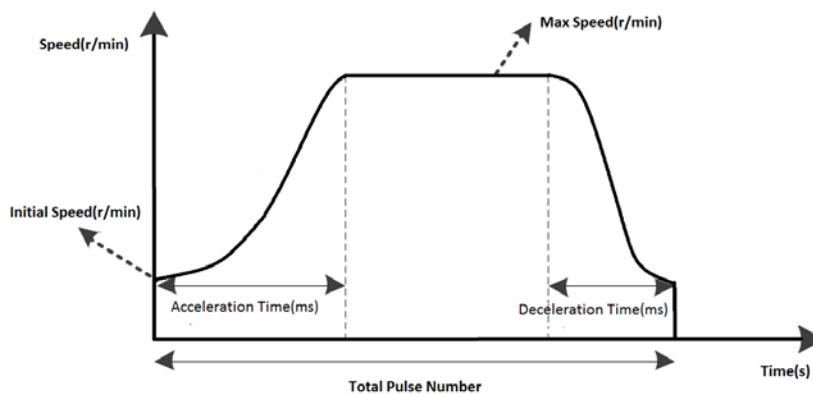


Profile position mode acceleration/deceleration curve

When the total pulse number set by user is small, the motor may need to decelerate before it accelerates to the maximum speed (that is, the motor does not accelerate to the maximum speed set by the user during actual operation). The speed curve is shown in the figure below. The solid line in the figure shows the actual running curve of the motor, and the dotted line is the curve that motor needs to run, to accelerate to the set maximum speed. The theoretical total pulse number is the minimum total pulse number calculated according to the user-set parameters (initial speed, maximum speed, acceleration time, deceleration time). When the total pulse number set by the user is less than the theoretical total pulse number, the motor will run as shown by the solid line in the figure.
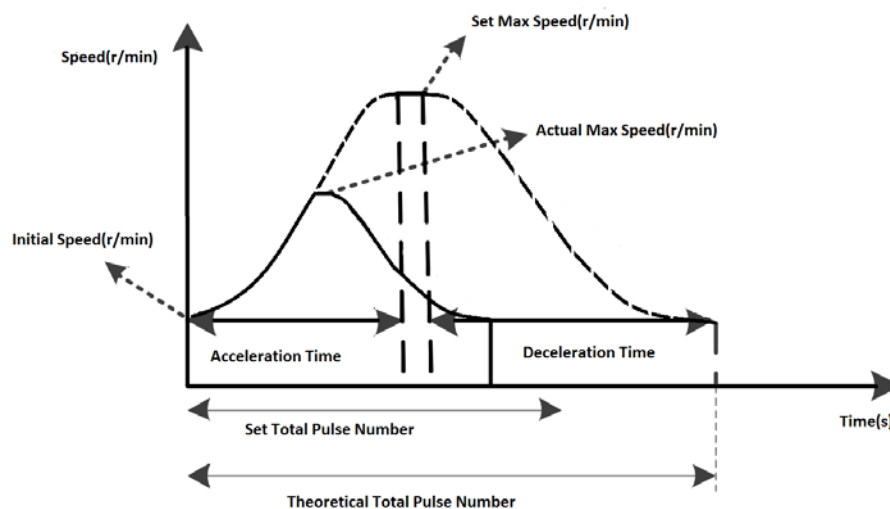


Profile position mode acceleration/deceleration curve (not accelerated to the set maximum speed)

## ※ Related Object Dictionary Content

| Index | Sub-Index | Name | Type | Attribute | Parameter Range | Setting |
|---|---|---|---|---|---|---|
| 6060h | 00 | Working Mode | I8 | RW | 0,1,3,6 | 1 |
| 607Ah | 00 | Total Pulse Number | I32 | RW | -1000000~1000000 | 3200 |
| 200Eh | 00 | Initial Speed | U32 | RW | 2-300 r/min | 5 r/min |
| 6081h | 00 | Max Speed | U32 | RW | 5-3000 r/min | 120 r/min |
| 6083h | 00 | Acceleration Time | U32 | RW | 0-2000ms | 100ms |
| 6084h | 00 | Deceleration Time | U32 | RW | 0-2000ms | 100ms |

### Control word and status word

The control word in Profile position mode is controlled by bit4 -bit6, bit8:

| Byte | Name | Function Description |
|---|---|---|
| Bit4 | New set-point | 0: No assumed target position;<br>1: Assumed target position; |
| Bit5 | Change set immediately | 0: Complete the current position and then start the next position;<br>1: Interrupt the current position and start the next position (unavailale at present); |
| Bit6 | ABS/REL | 0: The target position is an absolute value;<br>1: The target position is a relative value; |
| Bit8 | Halt | 0: Terminate current position;<br>1: Set deceleration to stop; |
| Note: According to the above table , the control word of absolute position motion command is 0x0F-> 0x1F, and the control word of relative position motion command is 0x4F-> 0x5F. | | |

## ※ Bit10, Bit12, Bit15 of status word display the driver status

| Byte | Name | Function Description |
|---|---|---|
| Bit10 | Target reached | 0: Halt = 0 target position has not been reached;<br>    Halt = 1 motor is decelerating;<br>1: Halt = 0 reach the target position;<br>    Halt = 1 motor speed is 0; |
| Bit12 | Set-point acknowledge | 0: The target position is pending;<br>1: The target position has taken effect; |
| Bit15 | Pend | 0: Not in position;<br>1: In position. |

### 3.3.2 Profile Position Mode Configuration Routine

Make the motor run relatively based on the parameters (acceleration time 100ms, deceleration time 100ms, maximum speed 60r / min, total pulse number 3200).

※ **Assume that the slave station number of the driver is 1. CANopen instruction control is described in the following table:**

| Master Station | Slave Station | Function Description |
|---|---|---|
| 601:<br>2B 40 60 00 00 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Initialize the driver state machine |
| 601:<br>23 83 60 00 64 00 00 00 | 581:<br>60 83 60 00 00 00 00 00 | Set acceleration time to 100ms |
| 601:<br>23 84 60 00 64 00 00 00 | 581:<br>60 84 60 00 00 00 00 00 | Set deceleration time to 100ms |
| 601:<br>23 81 60 00 3C 00 00 00 | 581:<br>60 81 60 00 00 00 00 00 | Set maximum speed 60r/min |
| 601:<br>23 7A 60 00 80 0C 00 00 | 581:<br>60 7A 60 00 00 00 00 00 | Set the total pulse number 3200 |
| 601:<br>2F 60 60 00 01 00 00 00 | 581:<br>60 60 60 00 00 00 00 00 | Switch operation mode<br>01 Profile position mode |
| 601:<br>2B 40 60 00 06 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Switch the driver state machine<br>(Refer to 402 protocol) |
| 601:<br>2B 40 60 00 07 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | |
| 601:<br>2B 40 60 00 0F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | |
| 601:<br>2B 40 60 00 4F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Send relative motion command 1 |
| 601:<br>2B 40 60 00 5F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Send relative motion command 2 |

**Note**: The target position must be written after the mode is set!

## 3.4. PROFILE VELOCITY MODE

### 3.4.1 Profile Velocity Mode Description

The acceleration curve in Profile velocity mode is shown in the figure below. Differ from Profile position mode, Profile velocity mode only needs to set 3 parameters: initial speed (address 200800h), target speed (address 608100h), acceleration time (address 608300h). After the motor accelerates to the maximum speed according to set 3 parameters , it will run uniformly at the maximum speed.
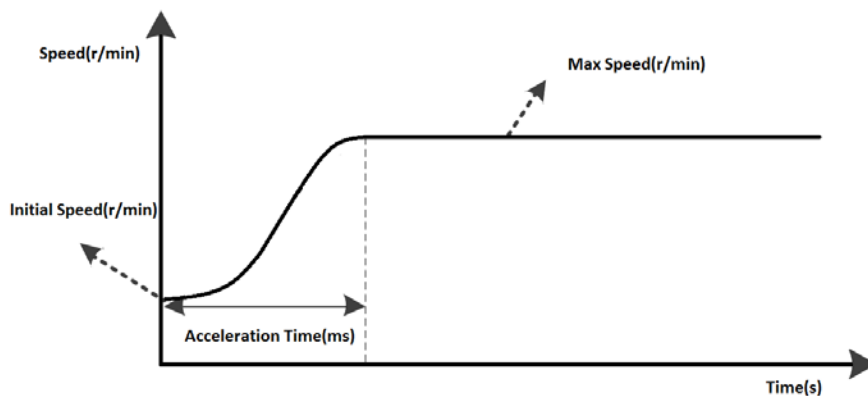
Profile Velocity Mode acceleration curve

※ **Related Object Dictionary Content**

| Index | Sub-Index | Name | Type | Attribute | Parameter Range | Setting |
|-------|-----------|------|------|-----------|-----------------|---------|
| 6060h | 00 | Operation mode | I8 | RW | 0,1,3,6 | 3 |
| 2008h | 00 | Initial Speed | U16 | RW | 2-300 r/min | 5 r/min |
| 60FFh | 00 | Target Speed | I32 | RW | -3000 r/min~3000 r/min | 120 r/min |
| 6083h | 00 | Acceleration Time | U32 | RW | 0-2000ms | 100ms |
| 6084h | 00 | Deceleration Time | U32 | RW | 0-2000ms | 100ms |

□
    **Control word and Status word**

※**Control word in profile velocity mode is controlled by bit8**

| Byte | Name | Function Description |
|------|------|---------------------|
| Bit8 | Halt | 0: Implement motion;<br>1: Stop motion. |

※ **Bit10 and Bit12 of status word display driver status**

| Byte | Name | Function Description |
|------|------|---------------------|
| Bit10 | Target reached | 0: Halt = 0 target speed has not been reached;<br>   Halt = 1 motor is decelerating;<br>1: Halt = 0 reach target speed;<br>   Halt = 1 motor speed is 0; |
| Bit12 | Speed | 0: Speed is not 0;<br>1: Speed is 0. |

## 3.4.2 Profile Velocity Mode Configuration Routine

Make the motor run based on the parameters (acceleration time 100ms, deceleration time 100ms, maximum speed 60r/min).

※ **Assume that the slave station number of the driver is 1. CANopen instruction control is described in the following table:**

| Master Station | Slave Station | Function Description |
|----------------|---------------|---------------------|
| 601:<br>2B 40 60 00 00 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Initialize the driver state machine |
| 601:<br>23 83 60 00 64 00 00 00 | 581:<br>60 83 60 00 00 00 00 00 | Set acceleration time to 100ms |
| 601:<br>23 84 60 00 64 00 00 00 | 581:<br>60 84 60 00 00 00 00 00 | Set deceleration time to 100ms |
| 601:<br>23 FF 60 00 3C 00 00 00 | 581:<br>60 81 60 00 00 00 00 00 | Set target speed 60rpm |
| 601:<br>2F 60 60 00 03 00 00 00 | 581:<br>60 60 60 00 00 00 00 00 | Switch operation mode<br>03 Speed mode |
| 601:<br>2B 40 60 00 06 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Switch the driver state machine<br>(Refer to 402 protocol) |
| 601:<br>2B 40 60 00 07 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | |
| 601: | 581: | |

| 2B 40 60 00 0F 00 00 00 | 60 40 60 00 00 00 00 00 | |

**Note**: The target speed must be written after the mode is set!

## 3.5. PROFILE TORQUE MODE

### 3.5.1 Profile Torque Mode Description

In Profile torque mode, the value of operation mode object 6060h needs to be set to 4. When the operation mode status reads the register of object 6061h as 4, the relevant operations of HM operation mode can be performed. The objects involved in this mode are as follows:

※ **Related Object Dictionary Content**

| Index | Sub-Index | Name | Type | Attribute | Parameter Range | Setting |
|-------|-----------|------|------|-----------|-----------------|---------|
| 6060h | 00 | Operation mode | I8 | RW | 0,1,3,4 | 4 |
| 6071h | 00 | Target torque | I32 | RW | -30000mA~30000 mA | 0 mA |
| 6083h | 00 | Acceleration time | U32 | RW | 0-2000ms | 100ms |

□
    **Control word and Status word**

※ **Control word in profile torque mode is controlled by bit8**

| Type | Name | Function Description |
|------|------|----------------------|
| Bit8 | Halt | 0: Implement motion; <br> 1: Stop motion. |

※ **Bit10 and Bit12 of status word display driver status**

| Type | Name | Function Description |
|------|------|----------------------|
| Bit8 | Torque attained | 0: torque has not been attained; <br> 1: attain torque; |
| Bit10 | Target reached | 0: Halt = 0 target torque has not been reached; <br>     Halt = 1 motor is acceleration; <br> 1: Halt = 0 reach target torque; <br>     Halt = 1 motor speed is 0; |

### 3.5.2 Profile Torque Mode Configuration Routine

Complete torque work, target torque is 100mA.

※ **Assume that the slave station number of the driver is 1. CANopen instruction control is described in the following table:**

| Master Station | Slave Station | Function Description |
|----------------|---------------|----------------------|
| 601: <br> 2B 40 60 00 00 00 00 00 | 581: <br> 60 40 60 00 00 00 00 00 | Initialize the driver state machine |
| 601: | 581: | Set target torque 100mA |

| 23 71 60 00 64 00 00 00 | 60 98 60 00 00 00 00 00 | |
|---|---|---|
| 601:<br>23 87 60 00 64 00 00 00 | 581:<br>60 9A 60 00 00 00 00 00 | Set torque deceleration time to 100ms |
| 601:<br>2F 60 60 00 04 00 00 00 | 581:<br>60 60 60 00 00 00 00 00 | Switch operation mode<br>04 Profile torque mode |
| 601:<br>2B 40 60 00 06 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Switch the driver state machine (Refer to 402 protocol) |
| 601:<br>2B 40 60 00 07 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | |
| 601:<br>2B 40 60 00 0F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | |

**Note**: the target torque must be written after the mode is set!

## 3.6. emergency stop instruction

| Master Station | Slave Station | Function Description |
|---|---|---|
| 601:<br>2B 40 60 00 02 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | The motor stops and keeps the shaft locked |

**Note**: Clear the target value after emergency stop!

| Master Station | Slave Station | Function Description |
|---|---|---|
| 601:<br>2B 40 60 00 0F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Driver enable |
| 601:<br>23 FF 60 00 3C 00 00 00 | 581:<br>60 23 FF 00 00 00 00 00 | Target speed |

**Note**: The second command rewrites the target speed!

| Master Station | Slave Station | Function description |
|---|---|---|
| 601:<br>2B 40 60 00 0F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Driver enable |
| 601:<br>23 7A 60 00 00 7D 00 00 | 581:<br>60 7A 60 00 00 00 00 00 | Set target postion 32000 |
| 601:<br>2B 40 60 00 4F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Relative position operation |
| 601:<br>2B 40 60 00 5F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | |

**Note**: The target position must be sent before "Relative position operation"!

| Master Station | Slave Station | Function description |
|---|---|---|
| 601:<br>2B 40 60 00 0F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Driver enable |
| 601:<br>2B 40 60 00 1F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Absolute position operation |

**Note**: After the second command is sent, the motor will run at the last target position!

**Contact emergency stop in torque mode:**

| Master Station | Slave Station | Function description |
|---|---|---|
| 601:<br>2B 71 60 00 E8 03 00 00 | 581:<br>60 71 60 00 00 00 00 00 | Set target torque 1000 |
| 601:<br>2B 40 60 00 0F 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Driver enable |

**Note**: The target torque must be before the enable command, otherwise the output current of the motor is 0, and the motor lock is released!

## 3.7 Clear the fault

| Master Station | Slave Station | Function description |
|---|---|---|
| 601:<br>2B 40 60 00 80 00 00 00 | 581:<br>60 40 60 00 00 00 00 00 | Clear the fault |

**Note**: Clear the target value after emergency stop!

## 4. OBJECT DICTIONARY

ZLAC8030L series bus type servo driver parameter register includes 3 parts: 1000h-1FFFh register defined by CIA301, 2000h-2FFFh register defined by the manufacturer and 6000h-6FFFh register defined by CIA402.

1000h-1FFFh register is CANopen related basic communication parameter defined by CIA301, including SDO, PDO, and mapping register.

2000h-2FFFh register is a manufacturer-defined register content, subdivision and current modification could be implemented within this group of parameters.

6000h-6FFFh register is motion parameter related to motion control defined by CIA402, including profile position mode, profile velocity mode, profile torque mode, other operation mode registers, and related motion parameter registers.

| Index | Sub-Index | Name | Description | Type | Attribute | PDO Mapping | Default |
|---|---|---|---|---|---|---|---|
| CiA301 Basic Communication Parameter Group ||||||||
| 1000h | 00 | Equipment type | This device supports CiA301, CiA402 protocol | U32 | RO | NO | 0X00040192 |
| 1001h | 00 | Error register | Driver current error status | U8 | RO | NO | 0 |
| 1005h | 00 | Synchronous message COB identifier | Synchronous message COB identifier | U32 | RW | NO | 0x80 |
| 1009h | 00 | Hardware version | Hardware version | U16 | RO | NO | - |
| 100Ah | 00 | Hardware version | Hardware version | U16 | RO | NO | - |
| 1014h | 00 | COB-ID emmergency | COB-ID emmergency | U32 | RW | NO | 0x80 |
| 1017h | 00 | Producer heartbeat | Producer heartbeat | U16 | RW/S | NO | 0 |

| | | interval | interval, unit: ms | | | | |
|---|---|---|---|---|---|---|---|
| 1018h | 00 | Manufacturer Information | Sub-index | U8 | RO | NO | 5 |
| | 01 | Vendor ID | Vendor ID | U32 | RO | NO | 0x0100 |
| | 02 | Product Code | Product Code | U32 | RO | NO | 0x0001 |
| 1200h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 2 |
| | 01 | COB-ID (Slave station receives) | COB-ID (Slave station receives) | U32 | RO | NO | 600h+Node-ID |
| | 02 | COB-ID (Slave station sends) | COB-ID (Slave station sends) | U32 | RO | NO | 580h+Node-ID |
| 1400h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 5 |
| | 01 | RPDO0-COB-ID | Identifier COB-ID | U32 | RO | NO | 200+Node-ID |
| | 02 | Transmission type | Transmission type | U8 | RW/S | NO | FFh |
| | 03 | Prohibition time | Prohibition time | U16 | RW/S | NO | 0 |
| | 04 | Maintain | Maintain | U8 | RW | NO | 0 |
| | 05 | Event timer | Event timer | U16 | RW/S | NO | 0 |
| 1401h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 5 |
| | 01 | RPDO1-COB-ID | Identifier COB-ID | U32 | RO | NO | 300+Node-ID |
| | 02 | Transmission type | Transmission type | U8 | RW/S | NO | FFh |
| | 03 | Prohibition time | Prohibition time | U16 | RW/S | NO | 0 |
| | 04 | Maintain | Maintain | U8 | RW | NO | 0 |
| | 05 | Event timer | Event timer | U16 | RW/S | NO | 0 |
| 1402h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 5 |
| | 01 | RPDO2-COB-ID | Identifier COB-ID | U32 | RO | NO | 400+Node-ID |
| | 02 | Transmission type | Transmission type | U8 | RW/S | NO | FFh |
| | 03 | Prohibition time | Prohibition time | U16 | RW/S | NO | 0 |
| | 04 | Maintain | Maintain | U8 | RW | NO | 0 |
| | 05 | Event timer | Event timer | U16 | RW/S | NO | 0 |
| 1403h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 5 |
| | 01 | RPDO3-COB-ID | Identifier COB-ID | U32 | RO | NO | 500+Node-ID |
| | 02 | Transmission type | Transmission type | U8 | RW/S | NO | FFh |
| | 03 | Prohibition time | Prohibition time | U16 | RW/S | NO | 0 |
| | 04 | Maintain | Maintain | U8 | RW | NO | 0 |
| | 05 | Event timer | Event timer | U16 | RW/S | NO | 0 |
| 1600h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 1 |
| | 01 | RPDO0-mapping 1 | Map to 6040h register | U32 | RW/S | NO | 60400010h |
| | 02 | RPDO0-mapping 2 | Not mapped | U32 | RW/S | NO | - |
| | 03 | RPDO0-mapping 3 | Not mapped | U32 | RW/S | NO | - |
| | 04 | RPDO0-mapping 4 | Not mapped | U32 | RW/S | NO | - |
| 1601h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 0 |
| | 01 | RPDO1-mapping 1 | Not mapped | U32 | RW/S | NO | - |
| | 02 | RPDO1-mapping 2 | Not mapped | U32 | RW/S | NO | - |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | 03 | RPDO1-mapping 3 | Not mapped | U32 | RW/S | NO | - |
| | 04 | RPDO1-mapping 4 | Not mapped | U32 | RW/S | NO | - |
| 1602h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 0 |
| | 01 | RPDO2-mapping 1 | Not mapped | U32 | RW/S | NO | - |
| | 02 | RPDO2-mapping 2 | Not mapped | U32 | RW/S | NO | - |
| | 03 | RPDO2-mapping 3 | Not mapped | U32 | RW/S | NO | - |
| | 04 | RPDO2-mapping 4 | Not mapped | U32 | RW/S | NO | - |
| 1603h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 0 |
| | 01 | RPDO3-mapping 1 | Not mapped | U32 | RW/S | NO | - |
| | 02 | RPDO3-mapping 2 | Not mapped | U32 | RW/S | NO | - |
| | 03 | RPDO3-mapping 3 | Not mapped | U32 | RW/S | NO | - |
| | 04 | RPDO3-mapping 4 | Not mapped | U32 | RW/S | NO | - |
| 1800h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 5 |
| | 01 | TPDO0-COB-ID | Identifier COB-ID | U32 | RO | NO | 180+Node-ID |
| | 02 | Transmission type | Transmission type | U8 | RW/S | NO | FFh |
| | 03 | Prohibition time | Prohibition time | U16 | RW/S | NO | 0 |
| | 04 | Maintain | Maintain | U8 | RW | NO | 0 |
| | 05 | Event timer | Event timer | U16 | RW/S | NO | 0 |
| 1801h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 5 |
| | 01 | TPDO1-COB-ID | Identifier COB-ID | U32 | RO | NO | 280+Node-ID |
| | 02 | Transmission type | Transmission type | U8 | RW/S | NO | FFh |
| | 03 | Prohibition time | Prohibition time | U16 | RW/S | NO | 0 |
| | 04 | Maintain | Maintain | U8 | RW | NO | 0 |
| | 05 | Event timer | Event timer | U16 | RW/S | NO | 0 |
| 1802h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 5 |
| | 01 | TPDO2-COB-ID | Identifier COB-ID | U32 | RO | NO | 380+Node-ID |
| | 02 | Transmission type | Transmission type | U8 | RW/S | NO | FFh |
| | 03 | Prohibition time | Prohibition time | U16 | RW/S | NO | 0 |
| | 04 | Maintain | Maintain | U8 | RW | NO | 0 |
| | 05 | Event timer | Event timer | U16 | RW/S | NO | 0 |
| 1803h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 5 |
| | 01 | TPDO3-COB-ID | Identifier COB-ID | U32 | RO | NO | 480+Node-ID |
| | 02 | Transmission type | Transmission type | U8 | RW/S | NO | FFh |
| | 03 | Prohibition time | Prohibition time | U16 | RW/S | NO | 0 |
| | 04 | Maintain | Maintain | U8 | RW | NO | 0 |
| | 05 | Event timer | Event timer | U16 | RW/S | NO | 0 |
| 1A00h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 0 |
| | 01 | RPDO1-mapping 1 | Not mapped | U32 | RW/S | NO | - |
| | 02 | RPDO1-mapping 2 | Not mapped | U32 | RW/S | NO | - |
| | 03 | RPDO1-mapping 3 | Not mapped | U32 | RW/S | NO | - |
| | 04 | RPDO1-mapping 4 | Not mapped | U32 | RW/S | NO | - |
| 1A01h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 0 |

| | 01 | RPDO1-mapping 1 | Not mapped | U32 | RW/S | NO | - |
|---|---|---|---|---|---|---|---|
| | 02 | RPDO1-mapping 2 | Not mapped | U32 | RW/S | NO | - |
| | 03 | RPDO1-mapping 3 | Not mapped | U32 | RW/S | NO | - |
| | 04 | RPDO1-mapping 4 | Not mapped | U32 | RW/S | NO | - |
| 1A02h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 0 |
| | 01 | RPDO2-mapping 1 | Not mapped | U32 | RW/S | NO | - |
| | 02 | RPDO2-mapping 2 | Not mapped | U32 | RW/S | NO | - |
| | 03 | RPDO2-mapping 3 | Not mapped | U32 | RW/S | NO | - |
| | 04 | RPDO2-mapping 4 | Not mapped | U32 | RW/S | NO | - |
| 1A03h | 00 | Number of sub-indexes | Number of sub-indexes | U8 | RO | NO | 0 |
| | 01 | RPDO3-mapping 1 | Not mapped | U32 | RW/S | NO | - |
| | 02 | RPDO3-mapping 2 | Not mapped | U32 | RW/S | NO | - |
| | 03 | RPDO3-mapping 3 | Not mapped | U32 | RW/S | NO | - |
| | 04 | RPDO3-mapping 4 | Not mapped | U32 | RW/S | NO | - |
| **Factory Custom Parameter Group** | | | | | | | |
| 2000h | 00 | Communication offline time | Driver and host communication offline time setting. Unit: ms Range: 0-32767; | U16 | RW/S | YES | 1000 |
| 2003h | 00 | Input signal status | 2 input signal level status; Bit0-Bit1: X0-X1 input level status; | U16 | RO | YES | 0 |
| 2004h | 00 | Output signal status | 2 output signal level status; Bit0-Bit1: Y0-Y1 output status; | U16 | RO | YES | 0 |
| 2005h | 00 | Clear feedback position | Used to clear feedback position in profile position mode 0: invalid; 1: clear the feedback position; Not saved. | U16 | RW | YES | 0 |
| 2006h | 00 | In absolute position mode, clear the current position | Used to clear the current position in absolute position mode 0: invalid; 1: clear the current position; | U16 | RW | YES | 0 |
| 2007h | 00 | Limit packing mode | 0: stop; 1: emergency stop; 2: invalid; | U16 | RW/S | YES | 0 |

| 2008h | 00 | Initial speed | The initial speed at which the movement begins; Unit: r/min; Range: 1-300 r/min; | U16 | RW/S | YES | 1r/min |
|---|---|---|---|---|---|---|---|
| 2009h | 00 | Register parameter setting | 0: invalid; 1: restore factory settings; 2: save all RW attribute parameters to EEPROM; | U16 | RW | YES | 0 |
| 200Ah | 00 | Maximum speed of motor | Maximum motion speed of the motor Unit: r/min; Range: 1-1000 r/min; | U16 | RW/S | YES | 1000 |
| 200Bh | 00 | Encoder wire setting | 0-4096 | U16 | RW/S | YES | 1024 |
| 200Ch | 00 | Motor pole pairs | 4-64 | U16 | RW/S | YES | 15 |
| 200Dh | 00 | CAN custom driver node number | When the external DIP switch is 0, CAN address could be set to 4-127; | U16 | RW/S | YES | 4 |
| 200Eh | 00 | CAN custom communication high baud rate | 0：1000 Kbit/s 1：500 Kbit/s 2：250 Kbit/s 3：125 Kbit/s 4：100 Kbit/s 5：50 Kbit/s 6：25 Kbit/s | U16 | RW/S | YES | 1 |
| 200Fh | 00 | Shaft lock method when power-on | 0: not enable, not lock the shaft; 1: not enable, lock the shaft; | U16 | RW/S | YES | 0 |
| 2010h | 00 | Whether save RW/S parameters in EEPROM synchronously | Whether the communication write function code value will be updated to EEPROM. 0: Parameters with attribute RW/S will be updated to EEPROM synchronously; 1: Not update; | U16 | RW | YES | 0 |
| 2011h | 00 | Offset angle of motor and Hall | Unit: 1°; Range: -360~+360. | I16 | RW/S | YES | 0 |
| 2012h | 00 | Overload factor | Range 0-300, Unit: %; | U16 | RO | NO | 200 |
| 2013h | 00 | Number of sub-indexes | Number of sub-indexes | U16 | RW/S | YES | 2 |
| | 01 | Motor temperature protection threshold | Unit: 0.1℃; Range: 0-1200 (* 0.1) | U16 | RW/S | YES | 800 |
| | 02 | Driver temperature | Unit: 0.1℃; | U16 | RW/S | YES | 800 |

| | | protection threshold | Range: 0-1200 (* 0.1) | | | | |
|---|---|---|---|---|---|---|---|
| 2014h | 00 | Rated current | The rated current output by the driver Unit: 0.1A; Range: 0-300. | U16 | RW/S | YES | 300 |
| 2015h | 00 | Maximum current | Maximum current output by the driver Unit: 0.1A; Range: 0-600. | U16 | RW/S | YES | 600 |
| 2016h | 00 | Overload protection time | Driver overload protection time Unit: 10ms; Range: 0-6553. | U16 | RW/S | YES | 300 |
| 2017h | 00 | Out-of-tolerance alarm threshold | Encoder out-of-tolerance threshold Unit: *10counts; Range: 1-6553. | U16 | RW/S | YES | 409 |
| 2018h | 00 | Velocity smoothing factor | 0-30000 | U16 | RW/S | YES | 1000 |
| 2019h | 00 | Current loop proportional coefficient | 0-30000 | U16 | RW/S | YES | 600 |
| 201Ah | 00 | Current loop integral gain | 0-30000 | U16 | RW/S | YES | 300 |
| 201Bh | 00 | Feedforward output smoothing coefficient | 0-30000 | U16 | RW/S | YES | 100 |
| 201Ch | 00 | Torque output smoothing factor | 0-30000 | U16 | RW/S | YES | 100 |
| 201Dh | 00 | Speed proportional gain Kp | 0-30000 | U16 | RW/S | YES | 500 |
| 201Eh | 00 | Speed integral gain Ki | 0-30000 | U16 | RW/S | YES | 100 |
| 201Fh | 00 | Speed feedforward gain Kf | 0-30000 | U16 | RW/S | YES | 1000 |
| 2020h | 00 | Position proportional gain Kp | 0-30000 | U16 | RW/S | YES | 50 |
| 2021h | 00 | Position feedforward gain Kf | 0-30000 | U16 | RW/S | YES | 200 |
| 2022h | 00 | RS485 custom driver node number | When the external DIP switch is 0, CANopen address could be set to 4-127; When the external DIP switch is 1-3, this bit is invalid. | U16 | RW/S | YES | 4 |
| 2023h | 00 | RS485 custom | 0：256000bps | U16 | RW/S | YES | 2 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | communication high baud rate | 1：128000bps<br>2：115200bps<br>3：57600bps<br>4：38400bps<br>5：19200bps<br>6：9600bps | | | | |
| 2025h | 00 | Software version | Factory default | U16 | RO | NO | - |
| 2026h | 00 | Number of sub-indexes | Number of sub-indexes | U16 | RO | YES | 2 |
| | 01 | Motor temperature | Unit: 0.1℃;<br>Range: -55~120℃ | I16 | RO | YES | 4 |
| | 02 | Driver temperature | Unit: 0.1℃;<br>Range: -55~-120℃ | I16 | RO | YES | - |
| 2027h | 00 | Motor status register | Driver controls motor movement<br>0: motor is stationary;<br>1: motor is running; | U16 | RO | YES | 0 |
| 2028h | 00 | Hall input status | 0-7;<br>If 0 or 7 appears, there is Hall error. | U16 | RO | YES | 0 |
| 2029h | 00 | Bus voltage | Unit: 0.01V | U16 | RO | YES | 0 |
| 202Ah | 00 | Speed observer coefficient 1 | 0-30000 | U16 | RW/S | YES | 1000 |
| 202Bh | 00 | Speed observer coefficient 2 | 0-30000 | U16 | RW/S | YES | 750 |
| 202Ch | 00 | Speed observer coefficient 3 | 0-30000 | U16 | RW/S | YES | 350 |
| 202Dh | 00 | Speed observer coefficient 4 | 0-30000 | U16 | RW/S | YES | 1000 |
| 202Eh | 00 | Number of sub-indexes | Number of sub-indexes | U16 | RO | NO | 5 |
| | 01 | Resistance of leakage resistor | Unit: 0.1 Ω<br>Range: 0-1000(*0.1) | U16 | RW/S | YES | 50 |
| | 02 | Power of leakage resistor | Unit: W<br>Range: 0-1000 | U16 | RW/S | YES | 100 |
| | 03 | Opening voltage of leakage resistor | Unit: 0.1V<br>Range: 360-750(*0.1) | U16 | RW/S | YES | 700 |
| | 04 | Closed voltage of leakage resistor | Unit: 0.1V<br>Range: 310-700(*0.1) | U16 | RW/S | YES | 620 |
| | 05 | Leakage function control | Leakage function open/closed:<br>0: closed;<br>1: open; | U16 | RW/S | YES | 0 |
| 202Fh | 00 | Number of sub-indexes | Number of sub-indexes | U16 | RO | YES | 2 |
| | 01 | Alarm PWM processing method | 0: close;<br>1: open | U16 | RW | YES | 0 |

| | 02 | Overload processing method | 0: close;<br>1: open | U16 | RW | YES | 0 |
|---|---|---|---|---|---|---|---|
| 2030h | 00 | Number of sub-indexes | Number of sub-indexes | U16 | RO | NO | 16 |
| | 01 | Input terminal effective level | Bit0: input terminal X0 control bit;<br>Bit1: input terminal X1 control bit;<br>Bit2 ~ Bit15: maintain;<br>0: default;<br>1: level reversal;<br>The driver defaults that the input terminal level rising edge or high level is effective; | U16 | RW/S | YES | 0 |
| | 02 | Input terminal X0 terminal function selection | 0: undefined;<br>1-6: NC;<br>9: emergency stop signal; | U16 | RW/S | YES | 9 |
| | 03 | Input terminal X1 terminal function selection | | U16 | RW/S | YES | 0 |
| | 04 | NC | | U16 | RW/S | YES | 0 |
| | 05 | NC | | U16 | RW/S | YES | 0 |
| | 0C | Output terminal effective level | Bit0: output terminal Y0 control bit;<br>Bit1: Y1 control bit of output terminal;<br>0: default;<br>1: level inversion;<br>The driver's default input terminal level rising edge or high level is valid; | U16 | RW/S | YES | 0 |
| | 0D | Output terminal Y0 terminal function selection | 0: undefined<br>1: alarm signal;<br>2: drive status signal;<br>3: NC;<br>4: In position signal; | U16 | RW/S | YES | 1 |
| | 0E | Output terminal B0 terminal function selection | Holding brake open/close<br>0: open<br>1: close; | U16 | RW | YES | 0 |
| | 0F | Output terminal Y1 terminal function selection | 0: undefined<br>1: alarm signal;<br>2: drive status signal;<br>3: NC;<br>4: In position signal; | U16 | RW | YES | 0 |

| CiA 402 Parameter Group | | | | | | | |
|---|---|---|---|---|---|---|---|
| 603Fh | 00 | Driver last fault code | Factory-defined drive error conditions. 0000h: no errors; FF01h: overvoltage; FF02h: undervoltage; FF04h:overcurrent; 0008h: overload; 0010h: current out-of-tolerance; 0020h: encoder out-of-tolerance; 0040h: speed out-of-tolerance; 0080h：reference voltage error; FF10h: EEPROM read and write errors; 0200h: Hall error; | U16 | RO | YES | 0 |
| 6040h | 00 | Control word | Control word | U16 | RW | YES | 0 |
| 6041h | 00 | Status word | Status word | U16 | RO | YES | 0 |
| 605Ah | 00 | Quick stop code | Driver processing method after quick stop command 5: stop normally, maintain quick stop state; 6: decelerate suddenly to stop, maintain quick stop state; 7: emergency stop, maintain quick stop state; | I16 | RW | NO | 5 |
| 605Bh | 00 | Close operation code | Driver processing method after close command 0: invalid; 1: stop normally, turn to ready to switch on state; | I16 | RW | NO | 1 |
| 605Ch | 00 | Disable operation code | Driver processing method after disable operation command 0: Invalid; 1: stop normally , switch to switched on state; | I16 | RW | NO | 1 |
| 605Dh | 00 | Halt control register | Driver processing method after the control word Halt command | I16 | RW | NO | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | 0: stop normally, maintaining Operation Enabled state; 2: decelerate suddenly stop, maintain Operation Enabled state; 3: emergency stop, maintain Operation Enabled state; | | | | |
| 6060h | 00 | Operating mode | 0: undefined; 1: profile position mode; 3: profile velocity mode; 6: profile torque mode; | I8 | RW | YES | 0 |
| 6061h | 00 | Operating mode status | 0: undefined; 1: profile position mode; 3: profile velocity mode; 6: profile torque mode; | I8 | RO | YES | 0 |
| 6064h | 00 | Actual position feedback | Actual position feedback, unit: counts; | I32 | RO | YES | 0 |
| 606Ch | 00 | Actual speed feedback | Current motor speed, Unit: 0.1r/min | I32 | RO | YES | 0 |
| 6071h | 00 | Target torque | Unit: mA; Range: -30000~30000; | I16 | RW | YES | 0 |
| 6074h | 00 | Real-time target torque | Unit: mA; Range:-30000~30000; | I16 | RO | YES | 0 |
| 6077h | 00 | Real-time current feedback | Unit: 0.1A; Range: -300~300; | I16 | RO | YES | 0 |
| 607Ah | 00 | Target position | Total number of pulses in profile position mode; Range: Relative position mode: -0x7FFFFFFF~0x7FFFFFFF; Absolute position mode: -0x3FFFFFFF~0x3FFFFFFF; | I32 | RW | YES | 0 |
| 6081h | 00 | Max speed | Speed in profile position mode; Range: 1-1000r/min; | U32 | RW | YES | 120r/min |
| 6082h | 00 | Start / stop speed in profile position mode | Start / stop speed in profile position mode; Range: 1-1000r/min; | U32 | RW | YES | 1r/min |
| 6083h | 00 | S-shaped acceleration time | acceleration time; Range: 0-32767ms; | U32 | RW | YES | 500ms |
| 6084h | 00 | S-shaped deceleration time | Deceleration time; Range: 0-32767ms; | U32 | RW | YES | 500ms |

| 6085h | 00 | Emergency stop deceleration time | Deceleration time; Range: 0-32767ms; | U32 | RW | YES | 10ms |
|-------|----|----|----|-----|-----|-----|------|
| 6087h | 00 | Torque slope | Current/1000/second; Unit: mA/s; | U32 | RW | YES | 300ms |
| 60FFh | 00 | Target speed | Target speed in profile velocity mode; Range: -1000~1000r/min; | I32 | RW | YES | 0 |
| Note: <br> ● U16 means unsigned 16 bits; I16 means signed 16 bits; U32 means unsigned 32 bits; I32 means signed 32 bits. | | | | | | | |

Notice:

Alarm PWM processing method: After the driver enters the alarm state, the upper tube is turned off and the lower tube is turned on (short-circuit motor 3 power cables).

Overload processing method: for example, the motor $I^2t$ time is 20s, the duration of double overload is 6 seconds, and the duration of triple overload is 4 seconds.